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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/788,593	02/27/2004	Waldean A. Schulz	SchulzWA-001	6811

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EXAMINER	
YEH, EUENG NAN	

ART UNIT	PAPER NUMBER
2624	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/788,593	SCHULZ, WALDEAN A.	
	Examiner	Art Unit	
	Eueng-nan Yeh	2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-46* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-46* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *27 February 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *Feb 27, 2004*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The disclosure is objected to because of the following informalities and appropriate corrections are required:

a) Paragraph 46, line 4, "words, without an intentional **blue**". The "**blue**" may be a typographical error of "**blur**".

Claim Objections

2. The following quotations of 37 CFR 1.75(a) and (d)(1) are the basis of objection:

> (a) The specification must conclude with a claim particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention or discovery.
>
> (d) (1) The claim or claims must conform to the invention as set forth in the remainder of the specification and the terms and phrases used in the claims must find clear support or antecedent basis in the description so that the meaning of the terms in the claims may be ascertainable by reference to the description.

3. Claims 17 to 20 and 40 to 43 are objected to under 37 CFR 1.75(d)(1), as failing to conform to the invention as set forth in the remainder of the specification.

- Regarding claims 17 and 40, line 2: "movable and scalable geometrical entity". There is no clear support or antecedent basis for the concept of "movable and scalable geometrical entity" in the description. Applicant may either point out where or how the original specification describes this limitation, or amend the specification to describe this feature without adding new matter.

- Regarding claims 18 to 20 and 41 to 43, same problem for the "geometrical entity" as mentioned above.

4. Claims 18, 19, and 20 are objected to under 37 CFR 1.75(a), as failing to particularly point out and distinctly claim the subject matter which application regards as his invention or discovery. Line 1 for above-mentioned claims "The system of claim 18". The "claim 18" appears to be a typographical error. In light of the corresponding written description of the invention, and for purpose of this examination, the following assumption will be used "A system of claim ~~18~~ **17**".

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1, 2, 3, 5 to 25, and 27 to 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Schulz et al. (US 6,141,104) and Palestini et al. (US 6,808,114 B1).

Regarding claim 1, Schulz discloses a system to determine the location of a point-like radiator of energy comprises:

at least one said point-like energy radiator (as depicted in figure 3, numeral 10 is "a point source of light 10, illustrated by a tiny infrared light-emitting diode (LED)" at column 8, line 61);

at least one said camera comprising an image reshaping means (as depicted in figure 3, numeral 25 is the aperture with slits to reshape the image. " almost any random irregular pattern of slits would be adequately effective in the practice of this invention" at column 12, line 28. Numeral 35 is the image), and

a pixel array, wherein each pixel array is an array of energy sensitive detectors (as depicted in figure 3, numerals 14 and 16 are image detector and photosensitive strip, respectively, numeral 35 is the image. "... detector may be a photosensitive semiconductor strip (in the case of a PSD) or a row of many discrete photosensitive

elements called pixels (in the case of a CCD or photodiode array). Area (or two-dimensional) position detectors may also be used ..." at column 2, line 20. See also "Two-dimensional aperture arrays and area image detectors could also use the methods described above ..." at column 14, line 38);

an image processing means to compute the location of the image of the radiator on each pixel array by identifying the center or some other reference point on the image to a precision of smaller than the size of each pixel ("...The image is then processed sequentially, pixel by pixel, using a conventional digital signal processor (DSP) to read, identify, and locate the displacement (of the center) of the image pattern in the midst of electronic noise using standard signal processing techniques ..." at column 10, line 65. See also " The precise actual displacement of the image pattern, as measured to a fractional pixel (sub-pixel), can be estimated by using well-known best-fit polynomial interpolation techniques ..." at column 11, line 49); and

said radiator location computing means to calculate the location of the radiator in the coordinate system, given the subpixel location of each image and a calibration function mapping said radiator image locations to the radiator location (as stated at column 11, line 62 to column 12, line 27. In a brief summary "... The location of the point radiation source is the intersection point in 3-D space of all the planes from all the multiple sensors. ..." at column 11, line 66. "... Given enough sensors at appropriate known locations and orientations, the coordinates of this point in some fixed coordinate system are unique and may be computed ..." at column 12, line 12).

Schulz does not explicitly disclose a lens system to the location detection system.

Palestini, in the same field of endeavor of optical study ("provide an apparatus and a method for reading optical code" at column 2, line 37), teaches a way to use lenses to gain enough luminosity on target object as depicted in figure 2, "... a collimating objective 46, comprised of one or more lenses, and, possibly, a diffractive element 44 or a hologram, arranged downstream of collimator 46, generating the desired luminous figure on plane P ..." at column 8, line 59.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the location determination system Schulz made with lens system as taught by Palestini, such that the image can be properly formed with " desired luminous" at Palestini column 8, line 63.

Regarding claim 2, said energy is visible light or is infrared light (as depicted in Schulz figure 3, numeral 10 is "a point source of light 10, illustrated by a tiny infrared light-emitting diode (LED)" at column 8, line 61).

Regarding claim 3, said radiator is a light-emitting diode, commonly known as an LED (discussed in claim 2).

Regarding claim 5, image forming means is a system comprising at least one lens (discussed in claim 1, "... a collimating objective 46, comprised of one or more

lenses, and, possibly, a diffractive element 44 or a hologram ..." at Palestini column 8, line 59).

Regarding claim 6, image forming means employs diffractive optics (discussed in claim 1, "... a collimating objective 46, comprised of one or more lenses, and, possibly, a diffractive element 44 or a hologram ..." at Palestini column 8, line 59).

Regarding claim 7, the aperture itself acting in the manner of the pinhole of a pinhole camera, but where the aperture is not an approximation of a single circular transparent disc (as depicted in Schulz figure 3, numeral 25 is the aperture with slits which is not a single circle transparent disc. " almost any random irregular pattern of slits would be adequately effective in the practice of this invention" at column 12, line 28).

Regarding claim 8, image reshaping means is a diffractive filter, of which a holographic filter is a special complex example (discussed in claim 1, "... a collimating objective 46, comprised of one or more lenses, and, possibly, a diffractive element 44 or a hologram ..." at Palestini column 8, line 59).

Regarding claim 9, said image reshaping means is a lens system and aperture designed to introduce a small amount of distortion to reshape a tiny circular spot image into an image which increases the perimeter-to-area ratio of the image by at least 50%

and spreads the image over more than 4 non-collinear pixels (as depicted in Schulz figure 3, numeral 25 is the aperture with multiple slits, m, each rectangular slit has width W and length L. " almost any random irregular pattern of slits would be adequately effective in the practice of this invention" at column 12, line 28.

Furthermore, by assuming that the width W and length L of a slit has the following relation L = n W, then the ratio R of perimeter of m slits and the circumference of a circle, with the m slits areas the same as that of the circle, can be derived as follows:

$$R = m (n+1) / SQRT(3.1416\ m\ n).$$

For n = 3, m = 2 => R = 1.843 (84.3%); m = 3 => R = 2.257 (126%).

For m = 2, n = 3 => R = 1.843 (84.3%); n = 4 => R = 1.995 (99.5%).

Thus, the size of slit n and the number of slits m can be adjusted to obtain the desired spreading condition).

Regarding claim 10, image reshaping means is a noncircular aperture (as depicted in Schulz figure 3, numeral 25 is the aperture with slits which is not a circle aperture).

Regarding claim 11, the aperture comprises at least one energy transparent area within an energy opaque mask ("These slits may be literal openings through a self-supporting opaque material, or they may be substantially transparent narrow elongated rectangular windows within a substantially opaque mask that is disposed on a transparent substrate" at Schulz column 6, line 66).

Regarding claim 12, at least one transparent area has a total perimeter-to-area ratio which is at least 50% greater than that of a circular disc (discussed in claim 9).

Regarding claims 13 and 14 (discussed in claim 1, "... a collimating objective 46, comprised of one or more lenses, and, possibly, a diffractive element 44 or a hologram ..." at Palestini column 8, line 59).

Regarding claim 15, each pixel array is a charge-coupled device commonly known as a CCD ("... detector may be a photosensitive semiconductor strip (in the case of a PSD) or a row of many discrete photosensitive elements called pixels (in the case of a CCD or photodiode array ..." at Schulz column 2, line 20).

Regarding claim 16, said image processing means employs a correlation function matched to the expected shape of the image of said radiator as imaged by the sensor ("...The precise actual displacement of the image pattern, as measured to a fractional pixel (sub-pixel), can be estimated by using well-known best-fit polynomial interpolation techniques. This can be done by using the pixel displacement with the maximum correlation value and by using several of its immediately neighboring correlation values on each side ..." at Schulz column 11, line 49. See also Schulz figure 7).

Regarding claim 17, said image processing means uses some best-fit criterion to map a movable and scalable geometrical entity onto the image on the pixel array, where the entity possesses at least a reference point, which point then defines the location of the image on the pixel array (discussed in claim 1, the best-fit polynomial interpolation technique to map a entity on the pixel array may be practiced without departing from the scope and spirit of Schulz's methodology. See also "... The location of the point radiation source is the intersection point in 3-D space of all the planes from all the multiple sensors. ..." at Schulz column 11, line 66).

Regarding claims 18, 19, 20, 41, 42 and 43 (discussed in claims 1 and 17 that the best-fit polynomial interpolation techniques used to match the geometrical entity for linear or area pixels).

Regarding claims 21, 22, 44, and 45, (discussed in claim 1. See also "In practice a digital signal processor (DSP) associated with each image detector would compute the correlation function to determine the exact image displacement. Then a standard floating point microprocessor, such as an Intel Pentium processor, would compute the XYZ coordinates of the location of the point source in the 3-D spatial coordinate system" at Schulz column 12, line 18).

Regarding claim 23, a location measurement system comprises:

coordinate system (discussed in claim 1 "Given enough sensors at appropriate known locations and orientations, the coordinates of this point in some fixed coordinate system are unique and may be computed ..." at Schulz column 12, line 12);

at least one point-like radiator of energy within the coordinate system (discussed in claim 1 for point-like energy radiator);

at least one energy sensor which forms an image of at least one radiator (discussed in claim 1 for a pixel array);

an image processor to find said image in the sensor and to calculate the location of said image in the sensor (discussed in claim 1 for image processing means);

a radiator location computer to calculate the location of each radiator relative to the coordinate system, given at least one image location and a calibration function mapping at least one said image location to a coordinate set representing the location in the coordinate system (discussed in claim 1 for radiator location computing means);

an image reshaping means in at least one said sensor, such that the image always covers at least 4 non-collinear pixels and the reshaping increases the number of pixels containing edges of the reshaped image compared to the original image by at least 50% (discussed in claim 9);

the image processor is adapted to process a reshaped image generated from the original image by the image reshaping means (discussed in claim 1 for image processing means).

Regarding claims 24 and 25 (discussed in claim 2).

Regarding claims 27 and 28 (discussed in claim 1 for lens system).

Regarding claim 29, said sensor includes an aperture acting in the manner of the pinhole of a pinhole camera, but the aperture is not a single circular disc (discussed in claim 7).

Regarding claims 30 and 31 (discussed in claim 8).

Regarding claim 32, said image reshaping means is a lens system intended to introduce a small amount of distortion in order to reshape a tiny circular spot image into an image which increases the perimeter-to-area ratio of the image by at least 50% and spreads the image over at least 4 non-collinear pixels (discussed in claim 9).

Regarding claim 33, said image reshaping means is an aperture (discussed in claim 1 for image reshaping means).

Regarding claim 34, the aperture comprises at least one energy transparent area within an energy opaque mask (discussed in claim 11).

Regarding claim 35, at least one transparent area has a total perimeter-to-area ratio which is at least 50% greater than that of a circular disc (discussed in claim 9).

Regarding claims 36 and 37 (discussed in claim 1, "... a collimating objective 46, comprised of one or more lenses, and, possibly, a diffractive element 44 or a hologram ..." at Palestini column 8, line 59).

Regarding claim 38, each pixel array is a charge-coupled device commonly known as a CCD ("... detector may be a photosensitive semiconductor strip (in the case of a PSD) or a row of many discrete photosensitive elements called pixels (in the case of a CCD or photodiode array ..." at Schulz column 2, line 20).

Regarding claim 39, said image processing means uses a correlation function matched to the expected shape of the image of said radiator as imaged by the sensor (discussed in claim 16).

Regarding claim 40, said image processing means uses some best-fit criterion to map a movable and scalable geometrical entity onto the image on the pixel array, where the entity possesses at least a reference point, which point then defines the location of the image on the pixel array (discussed in claim 17).

Regarding claim 46, a location determination system comprises:
placing a point-like energy radiator in said coordinate space (as depicted in Schulz figure 3, numeral 10 is "a point source of light 10, illustrated by a tiny infrared light-

emitting diode (LED)" at column 8, line 61. See also " the coordinates of this point in some fixed coordinate system are unique and may be computed ..." at Schulz column 12, line 13);

forming an image in at least one said sensor (discussed in claim 1 for a pixel array);

reshaping at least one such image (discussed in claim 1 for image reshaping means);

processing the image to determine its location in the sensor by identifying the center or some other reference point on the image to a precision of smaller than the size of each pixel (discussed in claim 1 for image processing means);

computing said radiator location coordinates describing the location of the radiator in the coordinate space, when given the subpixel location of sufficient images and given a calibration function mapping the image locations of the sufficient images to the radiator location (discussed in claim 1 for radiator location computing means).

7. Claims 4 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combination of Schulz and Palestini as applied to claims 1-3 and 23-25 discussed above, and further in view of Tondorf et al. (US 6,995,836 B1).

Regarding claims 4 and 26, the combination of Schulz and Palestini discloses that the energy radiator is a light-emitting diode (LED).

The combination of Schulz and Palestini does not explicitly disclose the said radiator can be a retro-reflector.

Tondorf, in the same field of endeavor of optical study ("relates to an angle measuring system for contactless angular measurements" at column 1, line 3), teaches

"... A retro-reflecting element is arranged on the second object whose relative angular change is to be measured, which reflects the light radiation, slightly offset, in the direction of the light source ..." at Tondorf column 9, line 6.

It would have been obvious at the time the invention was made to one of ordinary skill in the art to provide the said location determination system of Schulz and Palestini combination, to include the retro-reflector capability as taught by Tondorf, in order to have "... the advantage that only the components light source 1 and detector 2, arranged on an object, require electrical connecting lines, but the retro-reflecting element does not required them" at Tondorf column 9, line 12).

Conclusion

8. The prior arts made of record and not relied upon are considered pertinent to applicant's disclosure:

- Hamada et al. (US 6,085,039): figure 8, numeral 50 the diffraction grating.
- Ogawa (US 5,640,241): figure 8, numeral 10 the cross-shaped slit plate.
- Kohayakawa (US 5,523,809): figure 2, ring shape plate.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eueng-nan Yeh whose telephone number is 571-270-1586. The examiner can normally be reached on Monday-Friday 8AM-4:30PM EDT.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Brian P. Werner can be reached on 571-272-7401. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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